https://www.youtube.com/watch?v=7DfgfEGYeO8
https://www.youtube.com/watch?v=8cutulwQsY4

Thursday, December 08, 2016 8:44 AM

eg. A 700.0 kg car is moving at 5.0 m/s at the top of a hill, height of 10.0 m. The road is so icy, that it is essentially frictionless.

a) what is the kinetic energy of the car at the top of the hill?

$E_k = 1/2\ mv^2 = 1/2\ 700kgx(5m/s)^2$
$= 350x25 = 8{,}750J = 8.8kJ$

b) what is the gravitational energy of the car at the top?

$E_g = mgh = 700kgx9.80N/kgx10m$
$= 700x9.8x10 = 68{,}600.0 = 68.6kJ$

c) what is the total energy of the car (some books call it the mechanical energy)

$E_{total} = E_g + E_k = 68600 + 8{,}750 = 77350\ J$
$= 77.4kJ$

d) if no energy is lost as the car slides down, what is the speed of the car at the bottom of the hill?

$E_{totali} = E_{totalf}$
$= E_{gi} + E_{ki} = E_{gf} + E_{kf}$
$77350\ J = 0 + 1/2\ (700kg)v^2$
$v^2 = 2x77350/700 = 221$
$v = Sqrt(221) = 14.86606874731851$
$v = 14.9m/s$

e) the car slides up another hill 5.0m high. What is the speed at the top of that hill?

$E_{totali} = E_{totalf}$

$= E_{gi} + E_{ki} = E_{gf} + E_{kf}$

$77350\ J = 700kg \times 9.8N/kg \times 5.0m + 1/2(700kg)v^2$

$v = Sqrt((77350-(700 \times 9.8 \times 5))/350) =$
11.09053650640942
$v = 11.1m/s$

f) if the car is moving at 4.0 m/s at the top of the second hill, how much energy was lost in frictional force?

$E_{totali} = E_{totalf}$

$= E_{gi} + E_{ki} = E_{gf} + E_{kf} + E_{lost}$

$77350\ J = 700kg \times 9.8N/kg \times 5.0m + 1/2(700kg)(4m/s)^2 + E_{lost}$

$77350-((700 \times 9.8 \times 5)+(350 \times 16)) = 37450.0\ J$

37.4kJ lost as heat energy

e) write a paragraph describing how to drive in the snow given your knowledge of physics.

- coefficient of static friction / kinetic
- F=ma
- inertia
- kinetic and gravitational energy
- melting point of ice/pressure/friction?

increase the weight of your car, increases the normal force and increases the friction of the tires that provide forward force.

- get lots of friends, buy a bigger car, bag of sand or salt - can be used both for weight and for increasing friction directly

- go at a slow speed but try not to stop - inertia to keep going over icy parts

- better tires or chains to improve coefficient of friction
- build up speed going into a hill so kinetic energy is enough to overcome the gravitational energy of the hill

- ease on the accelerator and brake.
  -- static friction is higher than kinetic friction, so spinning or sliding tires have less friction than tires stationary relative to the ground.
  -- in the car crash video you should accelerate slightly in the direction of motion so the wheels are stationary relative to the ground.
  -- spinning tires melt snow, creating ice lowering friction. - never spin tires - ease off the accelerator - put in reverse, rock the car out of the icy part.

Assignment:

1. What is the lowest height you can drop a toy car or marble so that it can make a loop de loop?

b) what is the acceleration of the car at the bottom of the loop, in gs?

2. Pull a spring down and let it spring up to the ceiling. How far should you pull it down so that it just touches the ceiling?

p145-147 problems 19,23,25,31,33,41,43,45

Block 2-4

Go over questions from the board last class, read items from your paragraph

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$E_k = 1/2\ mv^2 = 1/2\ (700kg)\ (5m/s)^2$

350x25=8,750 J

8.8kJ

b) what is the gravitational energy of the car at the top?

$E_g = mgh$ =700kgx9.8N/kgx10m

700x98=68,600

68.6kJ

c) what is the total energy of the car (some books call it the mechanical energy)

$E_{total} = E_k + E_g$ = 8,750 J + 68,600 J

68,600+8750=77350 J

= 77.4 kJ

d) if no energy is lost as the car slides down, what is the speed of the car at the bottom of the hill?

$E_{totali} = E_{totalf}$

$E_{ki} + E_{gi} = E_{kf} + E_{gf}$

77350 J = 1/2 (700kg)v^2 + 0

v= Sqrt(77350/350)=14.86606874731851

v=14.9m/s

14.9x3.6=53.64

e) the car slides up another hill 5.0m high. What is the speed at the top of that hill?

$E_{totali} = E_{totalf}$

$E_{ki} + E_{gi} = E_{kf} + E_{gf}$

77350 J = 1/2 (700kg)v^2 + 700kg(9.8N/kg)5.0m
v= Sqrt((77350-(700x9.8x5))/350)=
11.09053650640942
11 m/s

700x9.80x5=34,300.0
77350-34300=43050

f) if the car is moving at 4.0 m/s at the top of the second hill, how much energy was lost in frictional force?

$E_{totali} = E_{totalf}$
$E_{ki} + E_{gi} = E_{kf} + E_{gf} + E_{lost}$ (Elost = $F_f$xd)
77350J=1/2(700kg)(4.0m/s)^2+
700kg(9.8N/kg)5.0m + E_{lost}
E_{lost} = 77350-(350x16)-(700x9.80x5.0)=37450.0
37kJ lost as heat - melt the snow create ice

g) write a paragraph describing how to drive in the snow given your knowledge of physics.
- coefficient of static friction / kinetic
- F=ma
- inertia
- kinetic and gravitational energy
- melting point of ice/pressure/friction?

take the skytrain because they have better snow removal on the tracks - plow trains and salt spreaders

fixed track, more wheels for more friction, more weight, so the normal force is greater so more friction for acceleration and deceleration

car you can put stuff - friends or bags of salt/sand in to increase the weight,

not losing energy to friction - snow tires or chains,

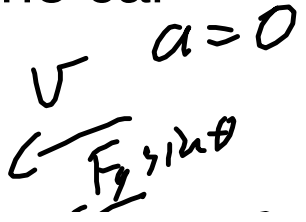
static friction is greater than kinetic friction so you should never lock the wheels, they should move with the ground so they are static in the frame of reference of the ground. (microscopic bumps lock in together, increasing static friction relative to kinetic friction where the bumps skip)

You should never spin the wheels - kinetic not static friction, lost as heat - melts the snow creates ice

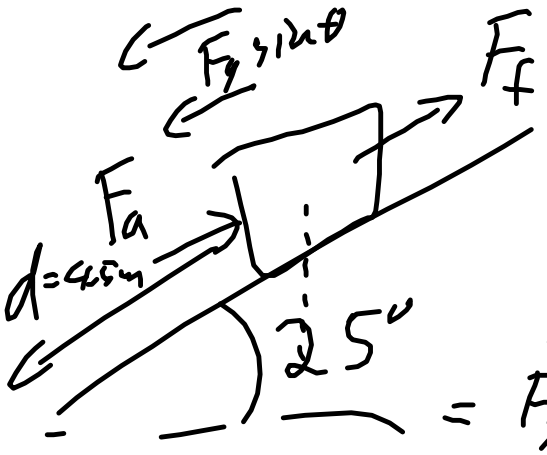
- ease on the accelerator - off if it spins - sometimes, back up and rock the car.

kinetic energy to overcome the gravitational energy of the bump or hill

put a shovel in the car



p144
Q9



$F_g \sin\theta = F_a + F_f$

$F_a = F_g \sin\theta - \mu_k m g \cos\theta$

$= F_g(\sin\theta - \mu_k \cos\theta)$

$F_g = 300\text{kg}\left(9.8\frac{N}{kg}\right)$ ($\sin 25° - 0.4\cos 25°$)

$0.4\cos$

$F_a \times d = -$ ( ) $\times 4.5\text{m}$

negative

$F_g \sin\theta \times d$

Block 2-2
Quiz Wednesday Dec 14th, Energy
today: go over questions
more review, calculus gravitational energy next class

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700x98=68,600 J

68.6kJ

c) what is the total energy of the car (some books call it the mechanical energy)

$E_{total} = E_g + E_k$ = 68,600+8,750=77,350

77.4 kJ

d) if no energy is lost as the car slides down, what is the speed of the car at the bottom of the hill?

$E_{totali} = E_{totalf}$

$E_{gi} + E_{ki} = E_{gf} + E_{kf}$

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11 m/s

f) if the car is moving at 4.0 m/s at the top of the second hill, how much energy was lost in frictional force?

$E_{totali}=E_{totalf}$

$E_{gi} + E_{ki} =E_{gf} + E_{kf} + E_{lost}$ ($E_{lost} =W_f=F_fd$)

77,350J = 700kg x9.80N/kgx5.0m+ 1/2(700kg) $(4.0m/s)^2 + E_{lost}$

E_{lost} = 77,350-(700x9.8x5)-(350x16)=37,450.0
= 37 kJ goes in to thermal energy - melt snow and make ice

g) write a paragraph describing how to drive in the snow given your knowledge of physics.
- coefficient of static friction / kinetic
- F=ma
- inertia
- kinetic and gravitational energy
- melting point of ice/pressure/friction?

take turns extra slow because coefficient of friction on snow/ice is very small. or walk - but watch for compacted snow/ice

salt on the road - melts the ice, creating groves to

give grip

F=ma to reduce the amount of force required lower the acceleration - ease on the accelerator and ease on the brake - never spin the tires and never lock the tires.

static friction is greater than kinetic friction
so ease on the accelerator going down a hill or pump brakes.

increase the weight of the car, increases FN
increases Ff - friends - bags of sand/salt -

coming to a hill - speed up so you have kinetic energy to overcome the gravitational energy

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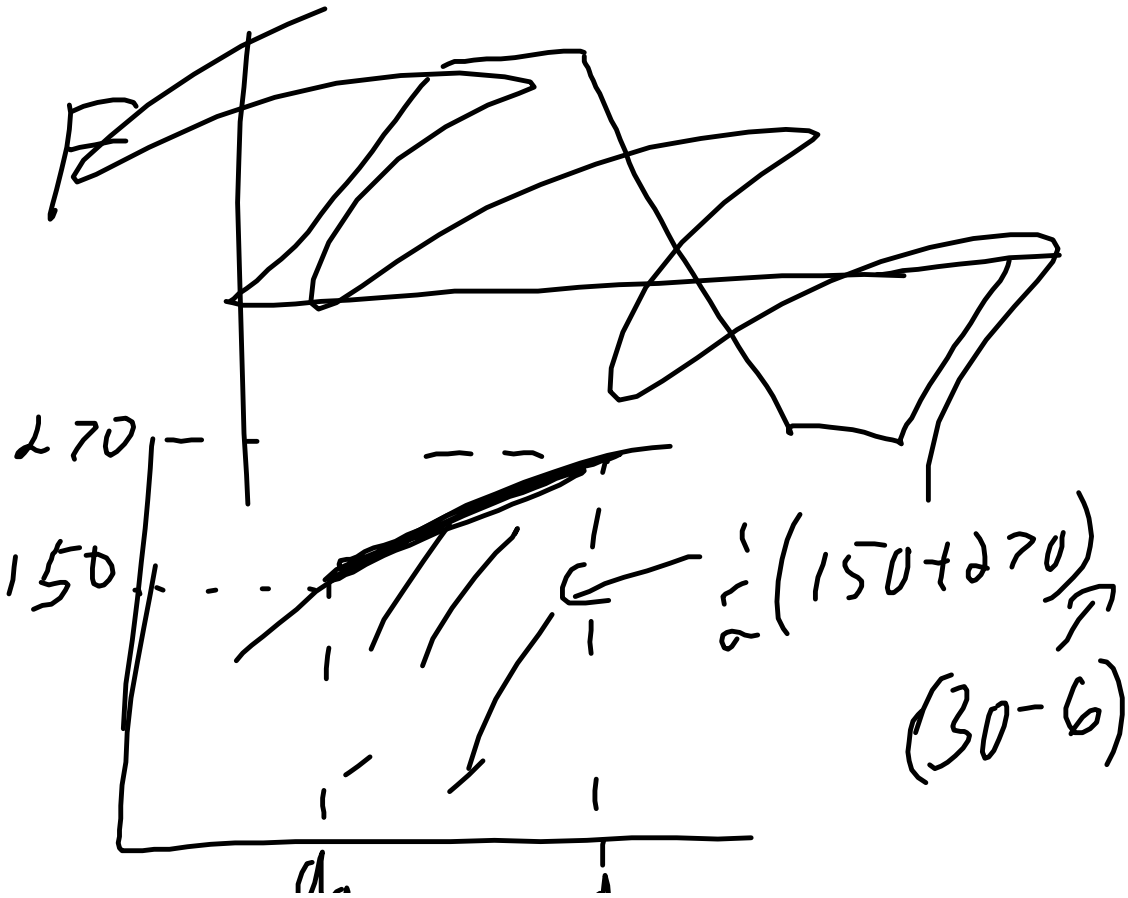
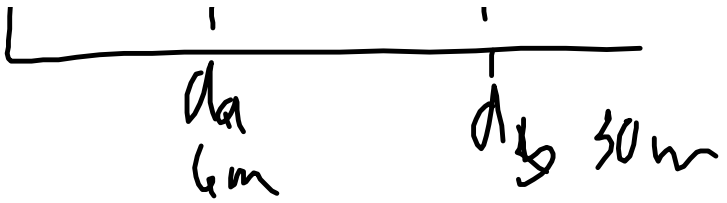
Q11





0.5x(150+270)x(30-6)=5,040
5.0 kJ

$W = \Delta e_{elastic} = 1/2\ kx_f^2 - 1/2kx_i^2$
$= 1/2\ (66N/m)[(0.055m)^2-(0.030m)^2]$
$= 33x((0.055x0.055)-(0.03x0.03))=0.0701\ J$